HIRDLS Overview and Status

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Progress

Progress since last Science Team Meeting:

Instrument continues to perform flawlessly except for the optical blockage. Further pitch manoeuvres have taken place to assist with HIRDLS calibration.

Ground data processing algorithms have been greatly improved.

Validation has continued.

Data have been delivered to the AVDC and DAAC.

Instrument Commanding and Performance

HIRDLS continues to take geophysical data almost 100% of time, with a view at a single azimuth angle.

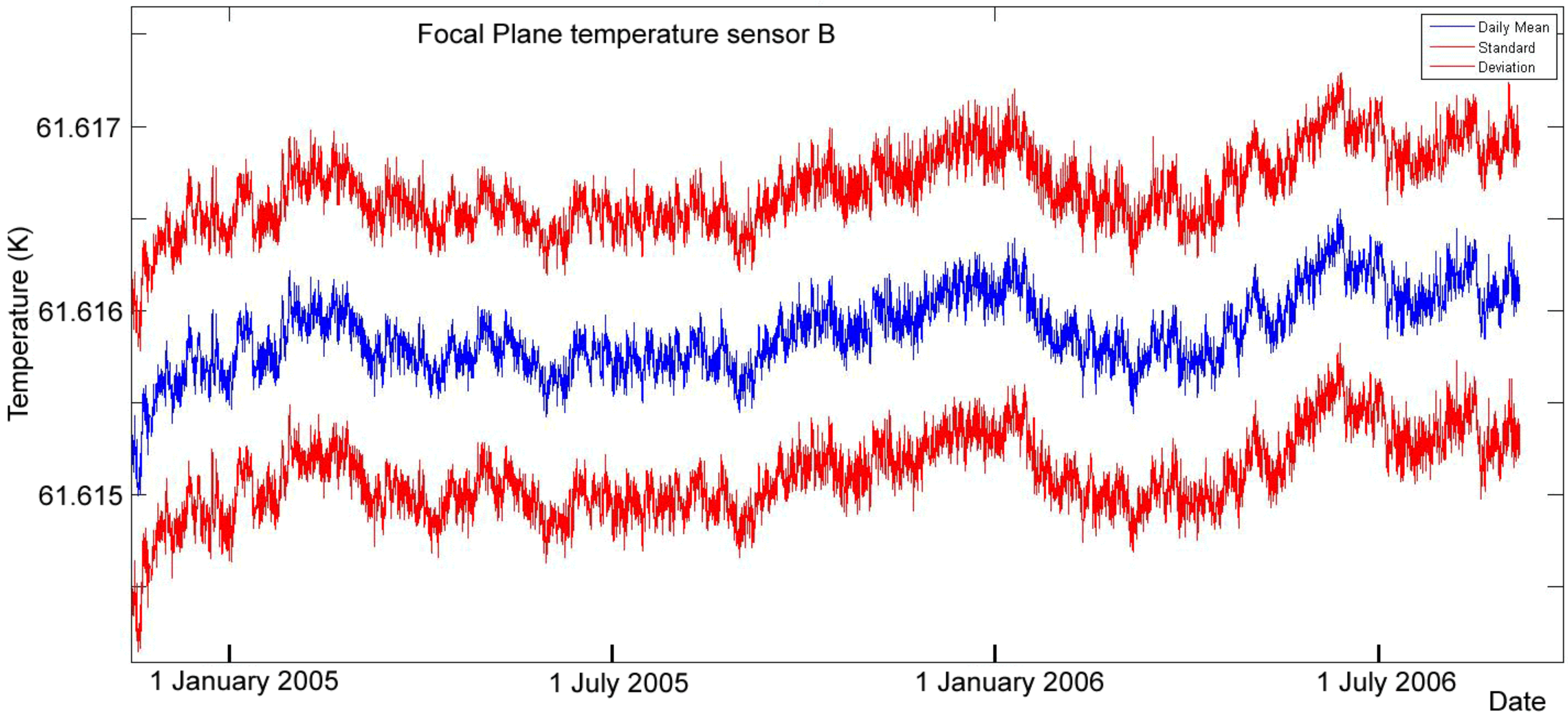
The standard scanning sequence was revised in May 2006 to give slower and larger vertical range scans to facilitate data correction.

Instrument trends are almost all negligible. Only notably exception is sunshield door warming, but only for a few minutes at sunset when the sun strikes it. This is to be expected with the normal degradation of thermal surfaces.

Detector temperature stability has been excellent – two orders of magnitude better than expected before launch, with almost no increase of cooler strokes (less than 1% since launch; >1% per month was thought likely).

Instrument Operating Flawlessly
Example- Cooler Performance

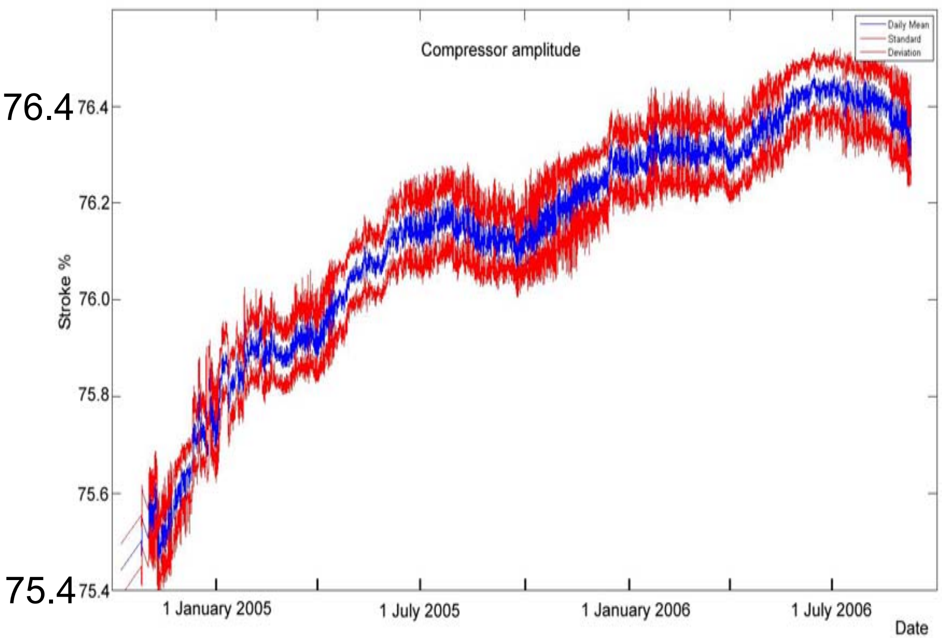
Focal Plane Temperatures have been maintained at 61.616 ± .001K since new control algorithm in November 2004.



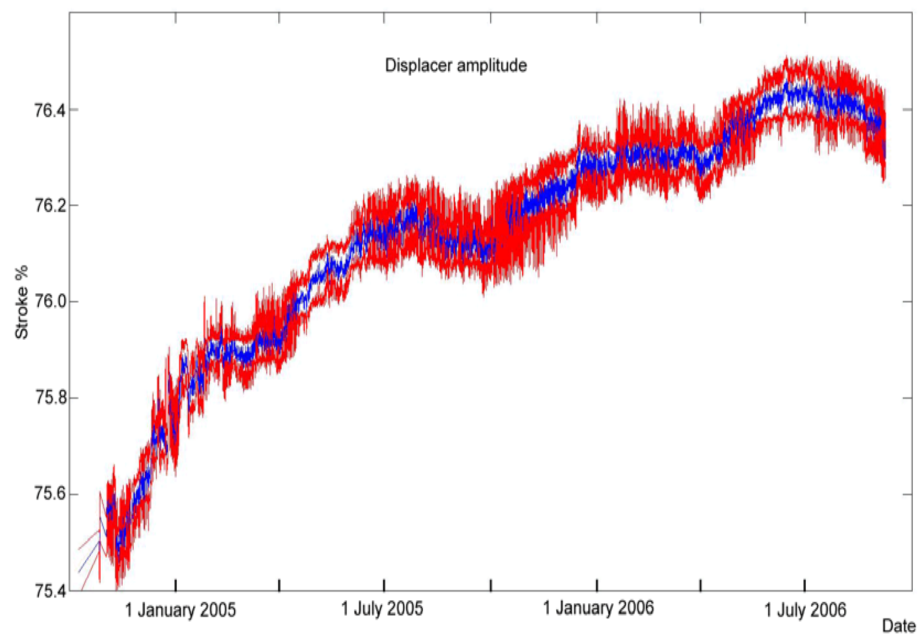
Cooler mechanism strokes

Compressor and displacer strokes have increased from 75.5% to 76.4%, => > 5 years before de-icing needed

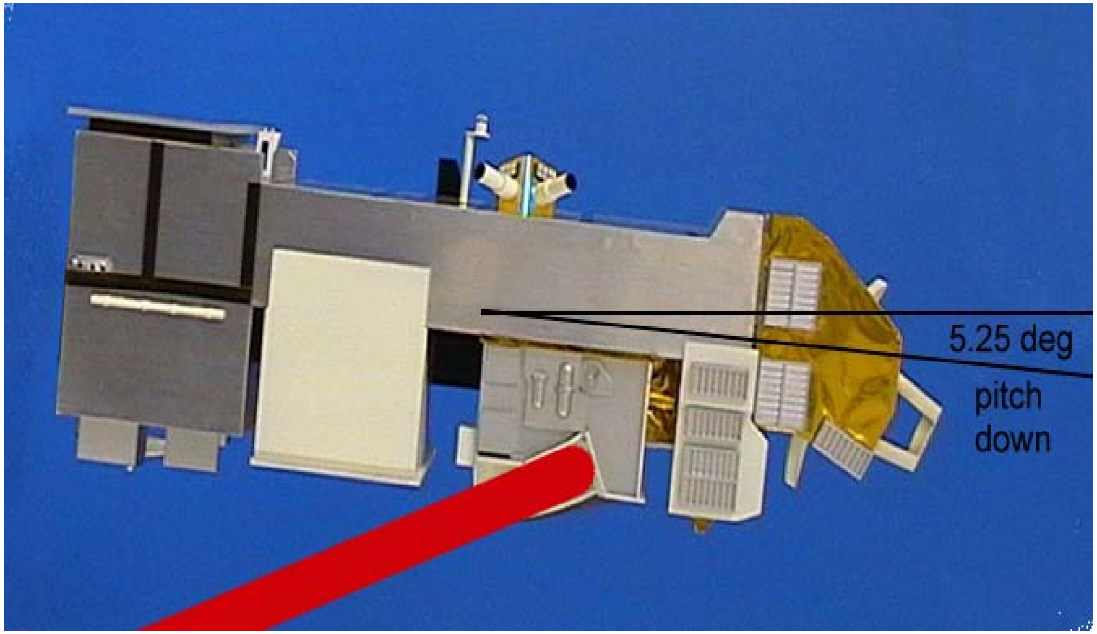
Compressor



Displacer



Pitch Manoeuvres

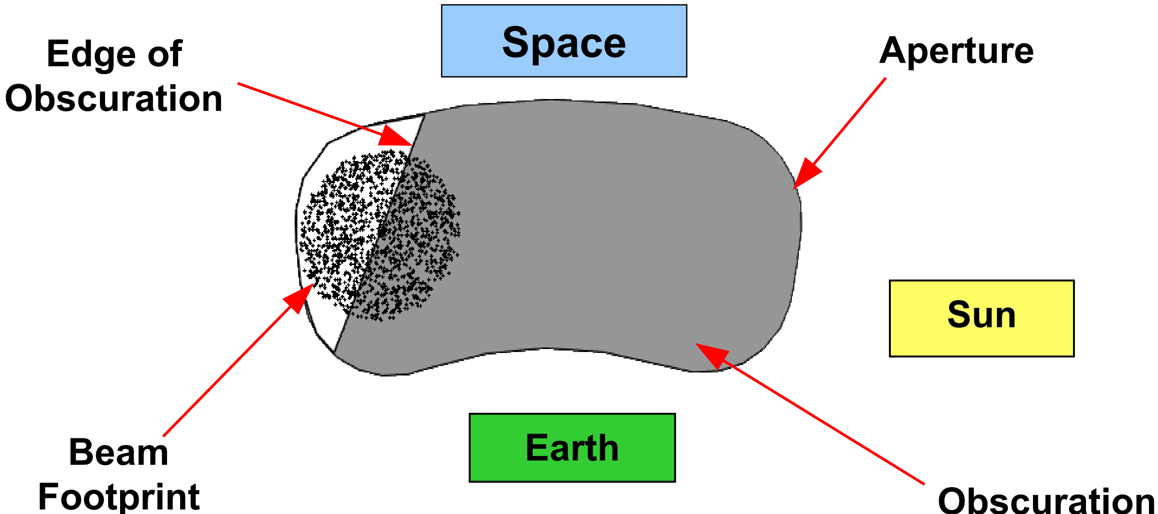


Three pitch manoeuvres have taken place since the last Science Team meeting (on days 53, 143 and 191) to obtain data at different solar beta angles (sun angles to the orbit plane).

The spacecraft was pitched by -2.62 deg or -5.25 deg. to cause the part of the HIRDLS scan range that views the atmosphere to view space.

This is a form of zero radiance calibration, but it also provides data to help measure the fraction of the beam unobscured and derive the oscillation correction algorithm.

Malfunction During Launch Created A Blockage Over Most of the Aperture



During launch we conjecture a piece of Kapton® came loose and covered much of the aperture, leaving only a fraction of an optical beam clear

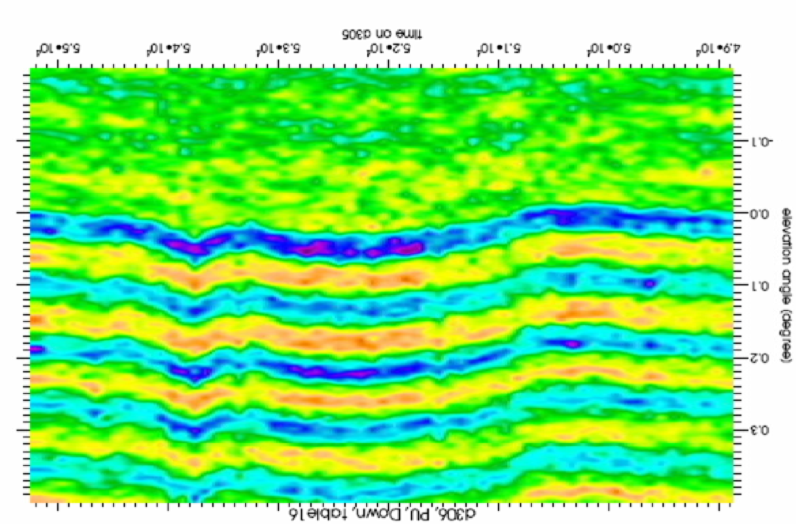
Obscuration covers most of aperture (5-20% of beam clear)

Beam has partial view to atmosphere at azimuth furthest from sun

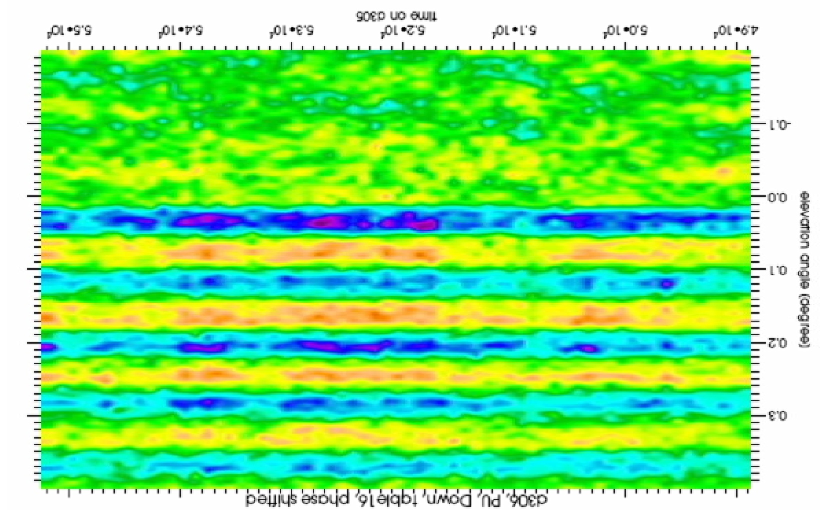
To use, scan vertically at single azimuth, add new algorithms for:

- Radiometric calibration
- Removal of effect of obstruction oscillation on radiance
- Removal of obstruction radiance from signal
- Correction for reduced area

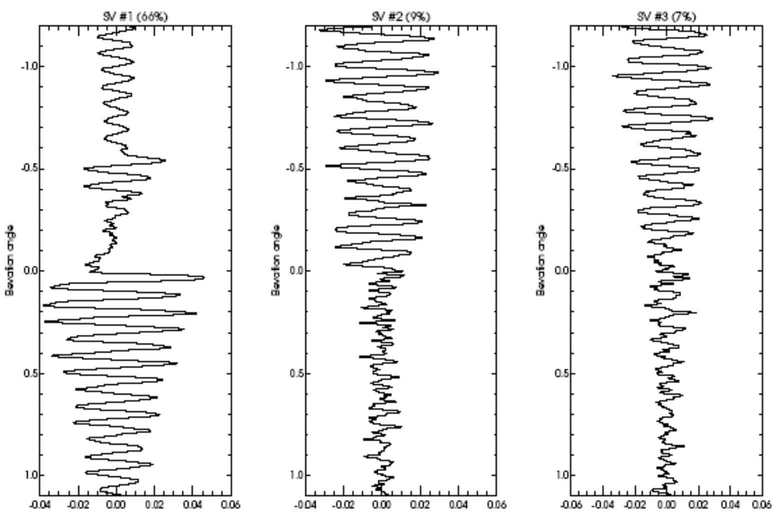
Oscillation Removal Approach
Focus on Oscillation Component



Phase shift



SVD



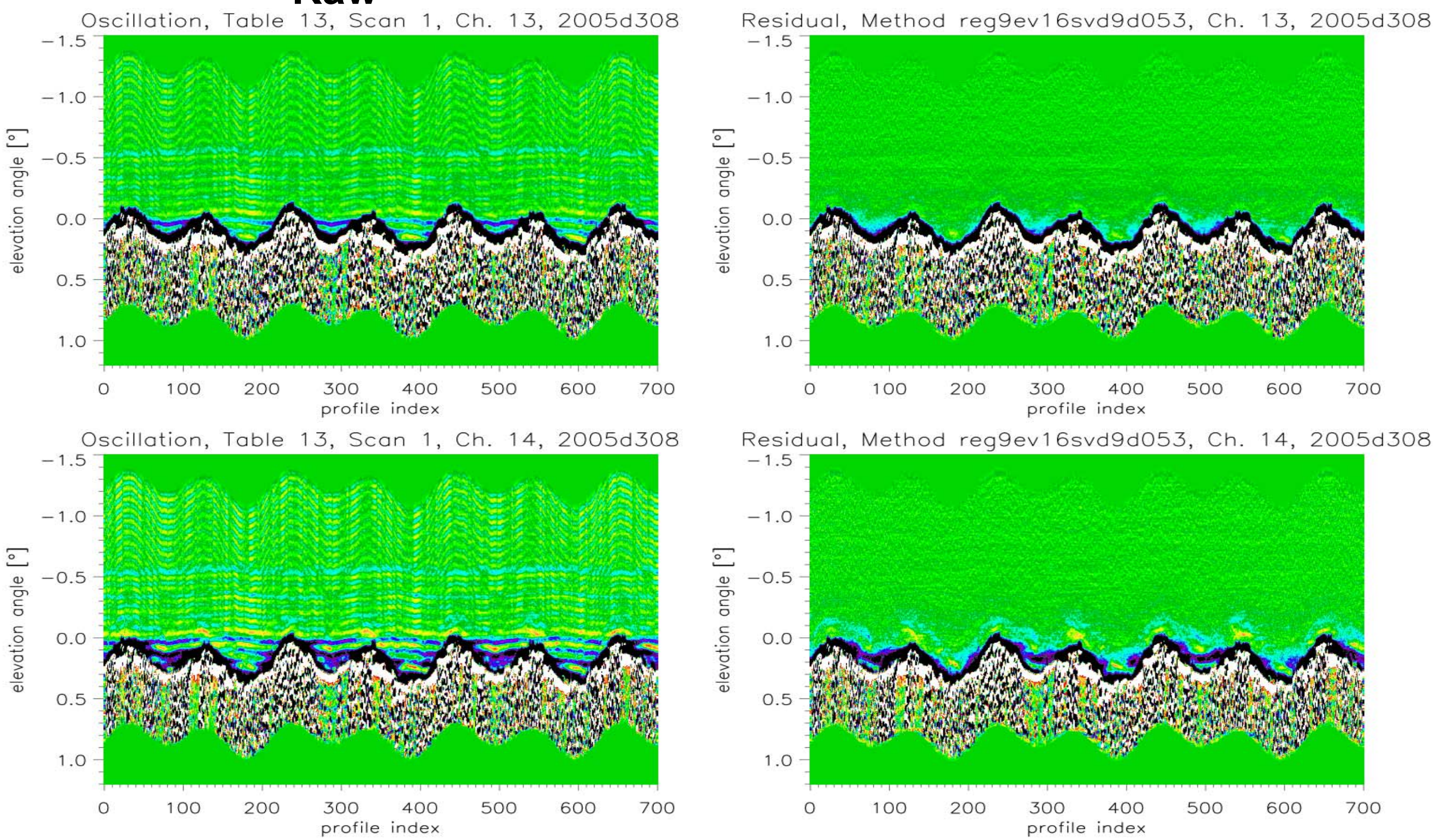
Critical difference from previous approach is removal of oscillation effects over whole elevation range.

Oscillation Removal: Demonstration of Current Status (Scan Table 13)

Raw | **Corrected**

Ch. 13

Ch. 14



Present version uses 16 EOFs, altitude-dependent scaling for channels ≠ 18.

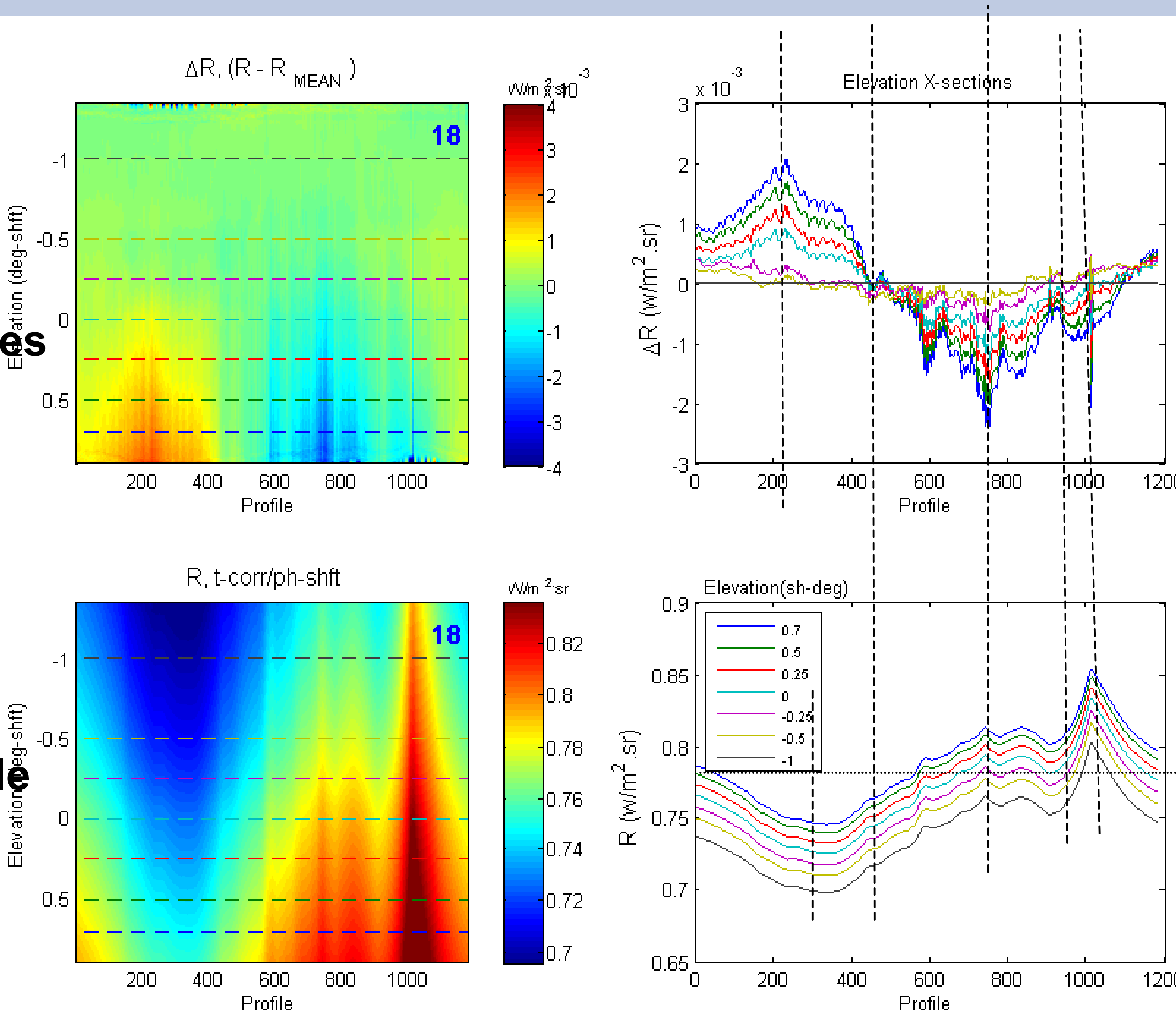
This shows results for Scan Table 13, now can be done for all ST's.

Much improved deoscillator has enabled improvements in other corrections.

Correction for Blockage Signal

Radiance corrected by simple physical model removes 95% of variations.

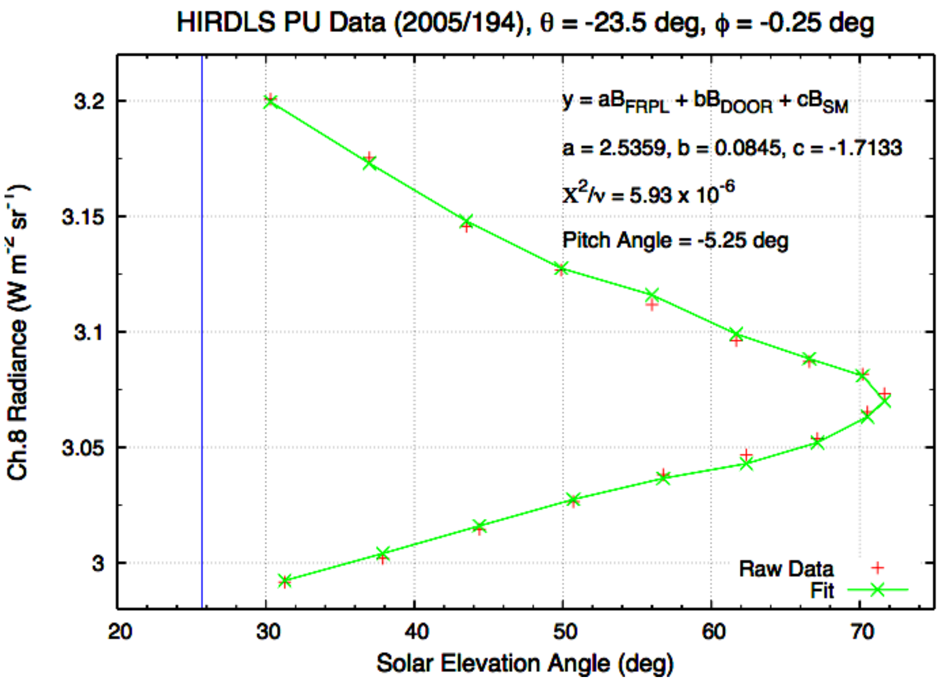
Blockage radiance as function of elevation angle and time.

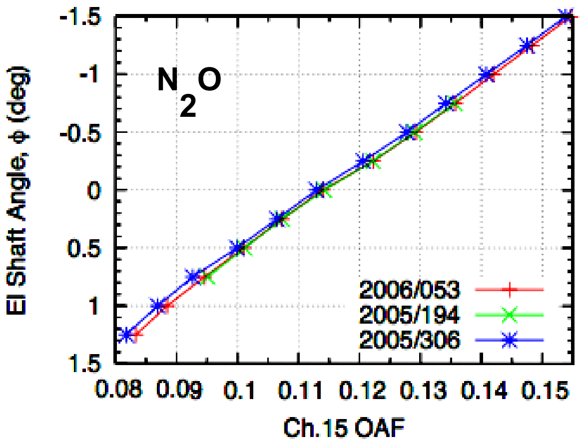


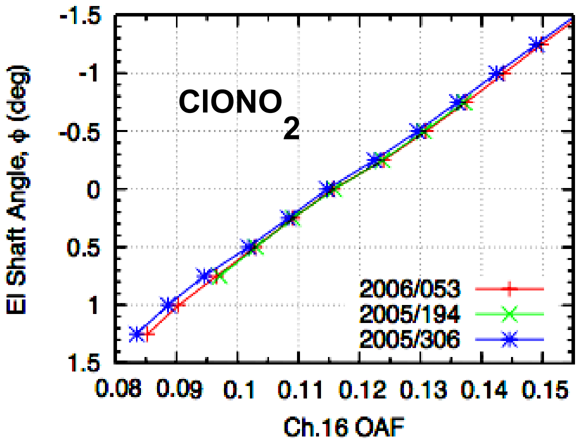
Cross-section of de-partures from mean due to vertical gradients.

Open Area Fraction from Modeling Radiometric Signal at -23.5° Azimuth

Sum of coefficients gives total radiative contributions. Difference from those at -14° (completely on blockage) gives Open Area Fraction







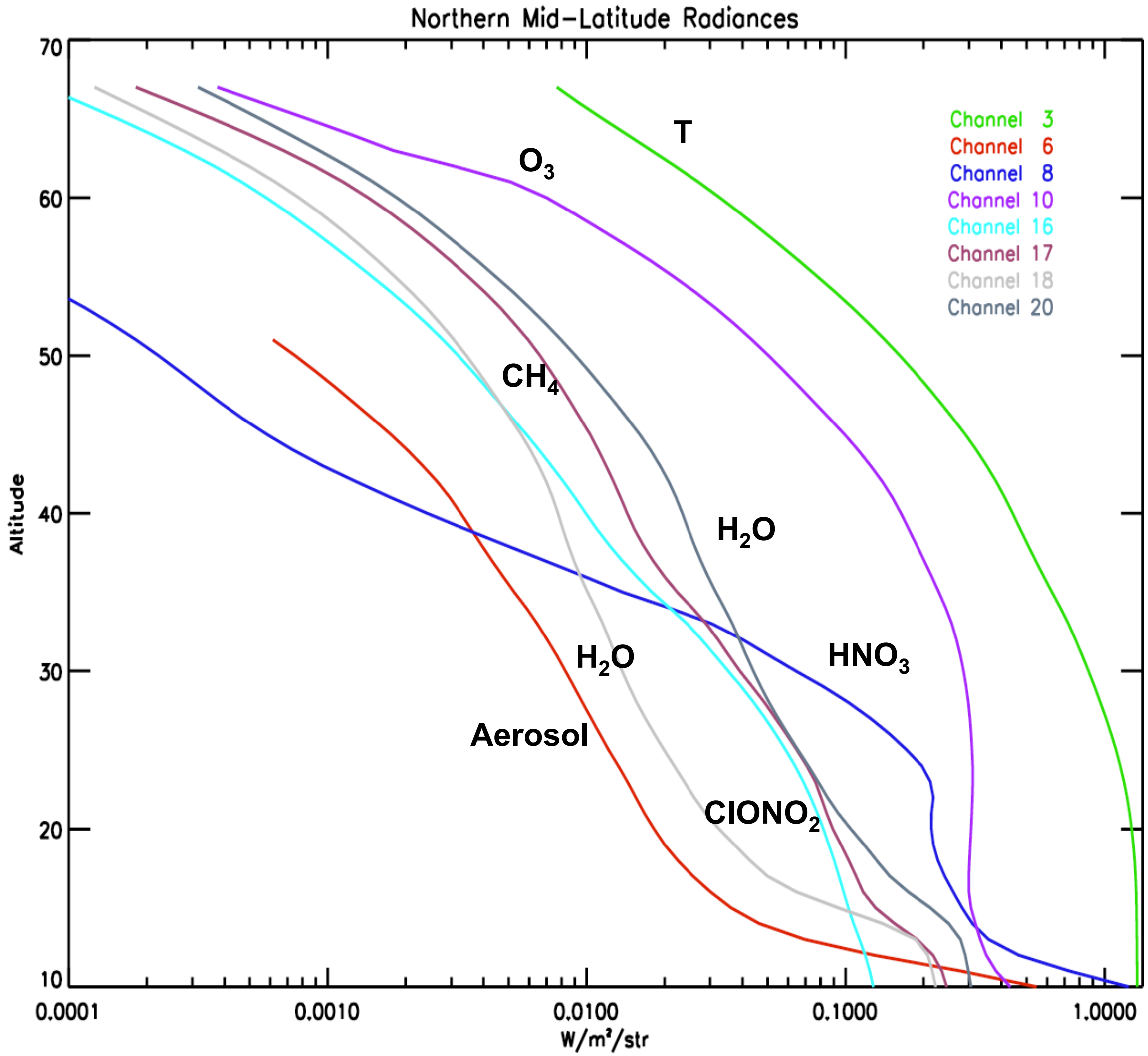
Model equation does a good job in capturing the SC nighttime (only) orbital radiance behaviors at -23.5°.

Similar results are observed for the "Kapton-only" vertical scans at -14.0°.

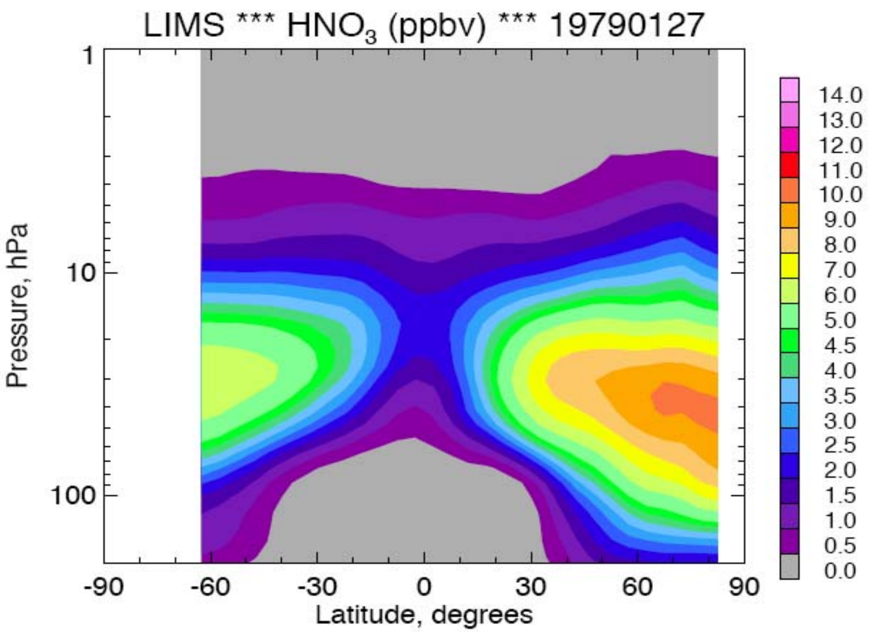
Result s

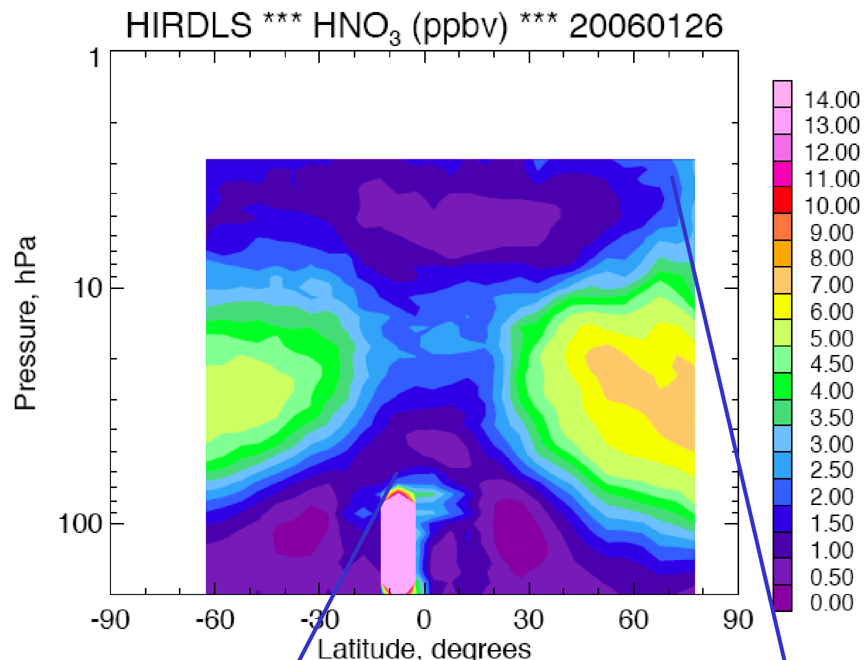
Corrections and Radiance Magnitudes

- Atmospheric radiances from HIRDLS channels span ~ 4 orders of magnitude
- Initial success for T and O_3 was for channels with largest radiances, O(1), most tolerant to correction errors
- Challenge- reduce correction errors so other channels, O(-1), produce useful data



HNO_3- January (1979; 2006)
Binned profiles: 5° lat. x 20° long.





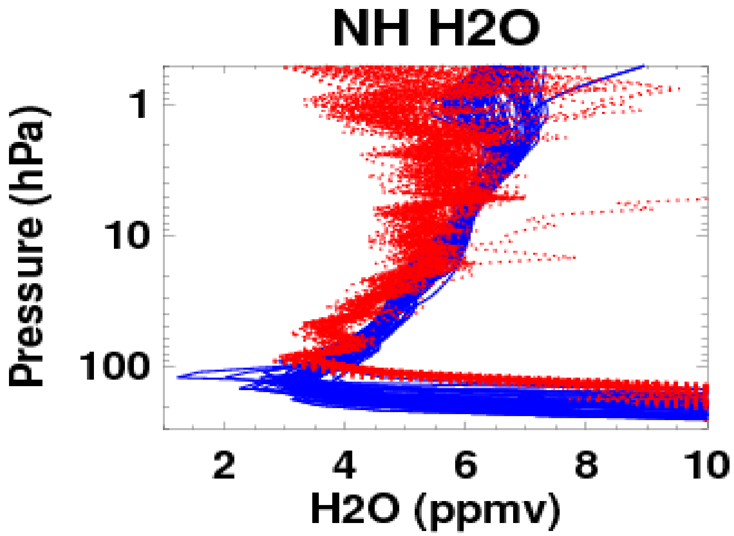
Correct Winter/Summer Asymmetry represented in HIRDLS (more HNO_3 in NH)

Cloud signatures

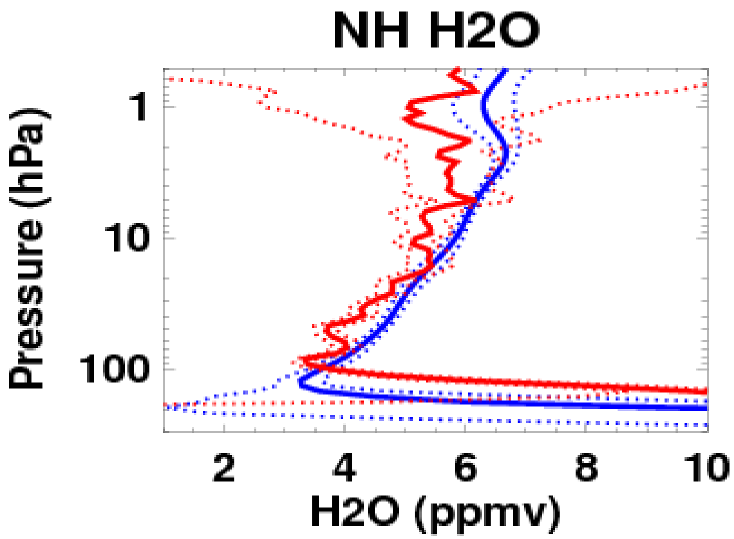
Retrieval issues in the upper stratosphere, polar region

Doug Kinnison

HIRDLS & ACE
Water Vapor Profiles



All Coincidences within 2 hours.
These all near 65 °N.



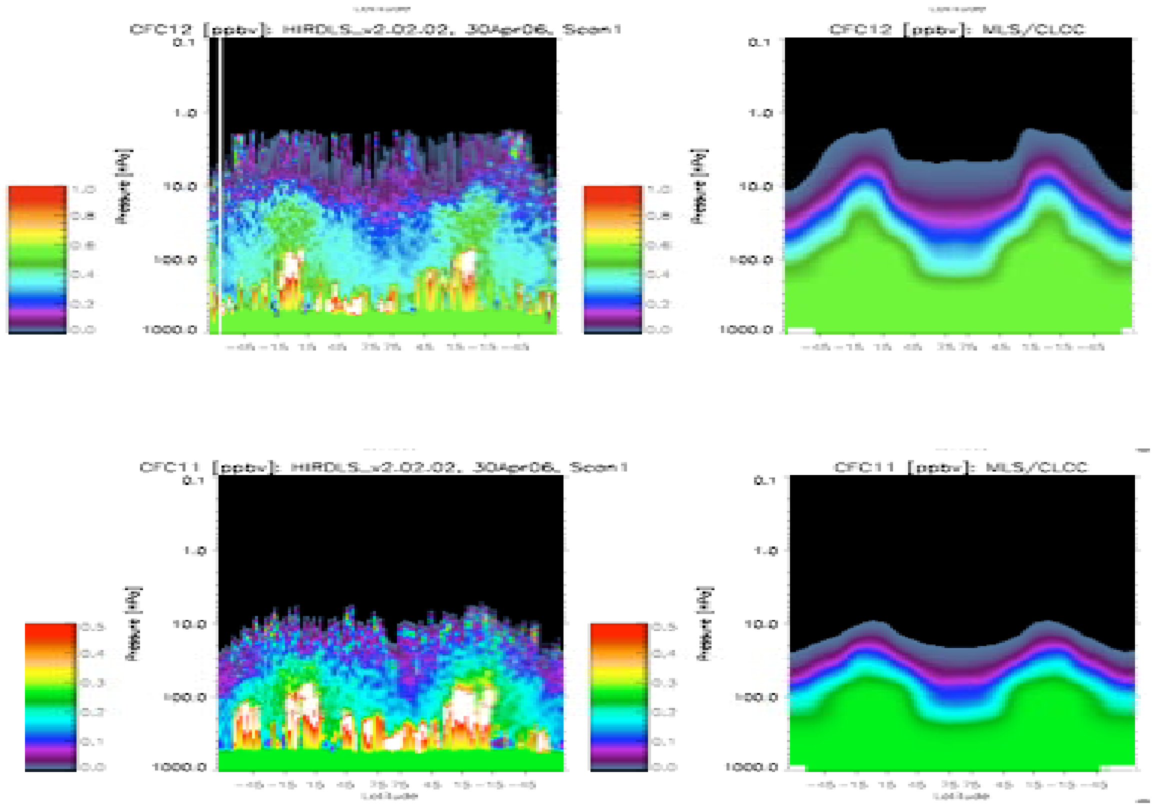
Average (solid) & 1-σ standard deviation (dotted)

Cora Randall-Thanks also to Peter Bernath and the ACE Team

CFC 11 and 12 also Looking very Promising

CFC 12

CFC 11



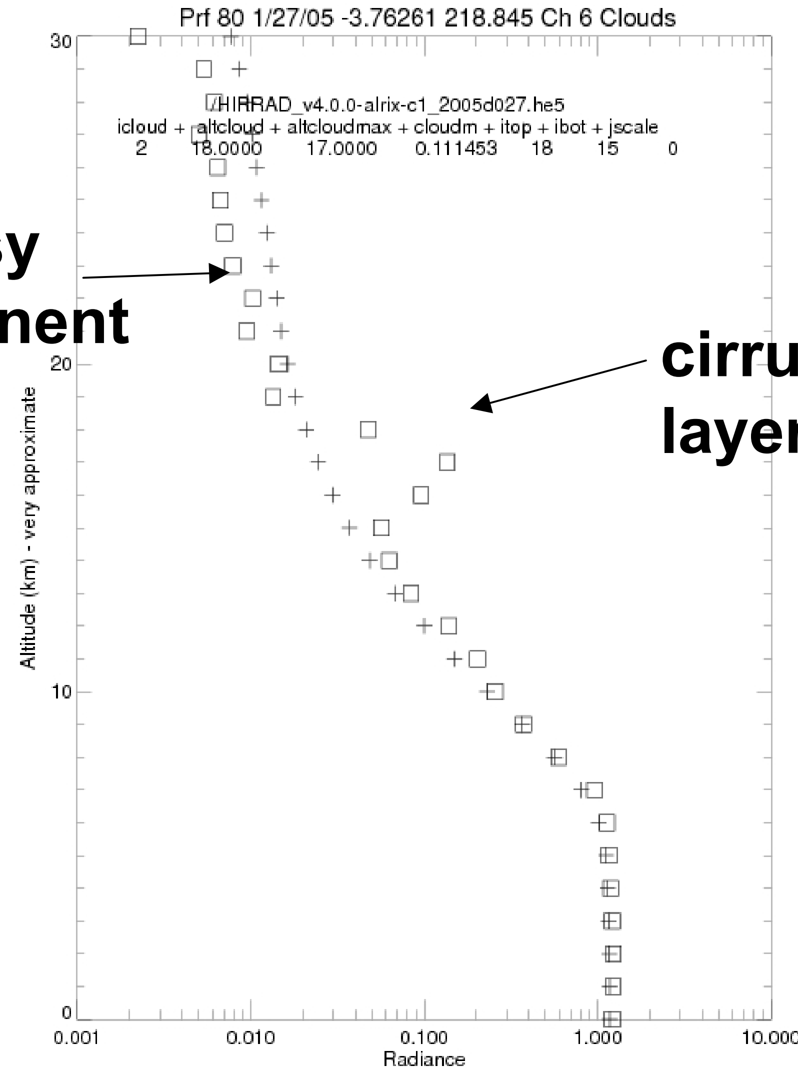
In spite of these channels being in the corner of the focal plane that is most obscured, The morphology is correct, especially with the tropical upwelling, and the mean values are approximately correct.

With the recovery of mean values, the source of the high variability has become one of the next problems to solve.

Tropical Cirrus Layer

HIRDLS has the capability, unique on Aura, of detecting very thin cirrus, and determining their altitudes.

This example illustrates the appearance of a very thin cirrus layer in the HIRDLS radiance profiles. The limit of detectability is set by the size of the random component.



Steve Massie

Description of HIRDLS Data Versions

Data Version	Contains	Comments
2.00	Baseline. ST 23 only	In AVDC & DISC
2.02	Improved cloud top detection. ST 22 & 23	In internal evaluation
2.02.02	ST 13 + 22 & 23	Being evaluated, run last week
2.02.03	ST 30 + 13 + 22 & 23	Being evaluated, run last week
2.03 (Planned)	Improved pointing Updated calibration Improved cloud tops Refined de-osc.	To be released

ST 30: 21/1/05 - 27/4/05; 13: 28/4/05 - 24/4/06; 22: 25/4/06-3/5/05; 23: 4/5/06-present

Accomplishments and Prospects

Algorithms continue to be improved, made more robust and general. Software implementation continues, to allow raw data (L0) to be processed to Atmospheric Data (L2)

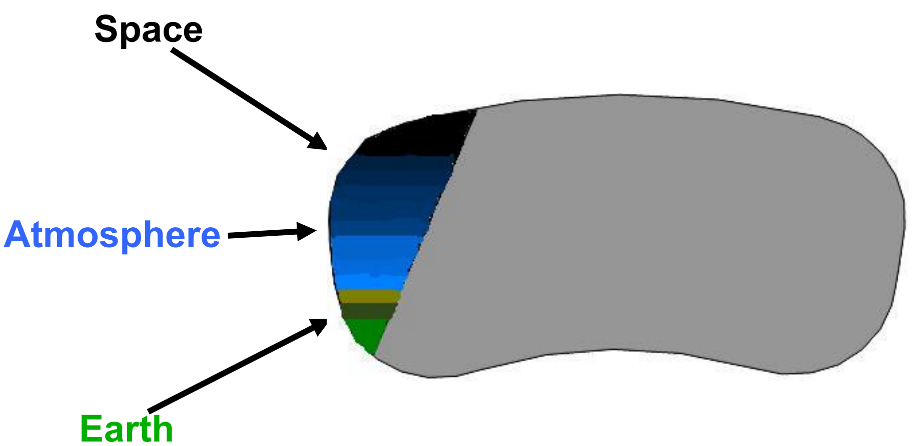
- Oscillation correction algorithm a recent outstanding success
- Significant progress on other corrections continues to be made
- Retrieved temperature and ozone fields (~ 1 km vertical resolution) have improved since last Aura Science Team meeting;

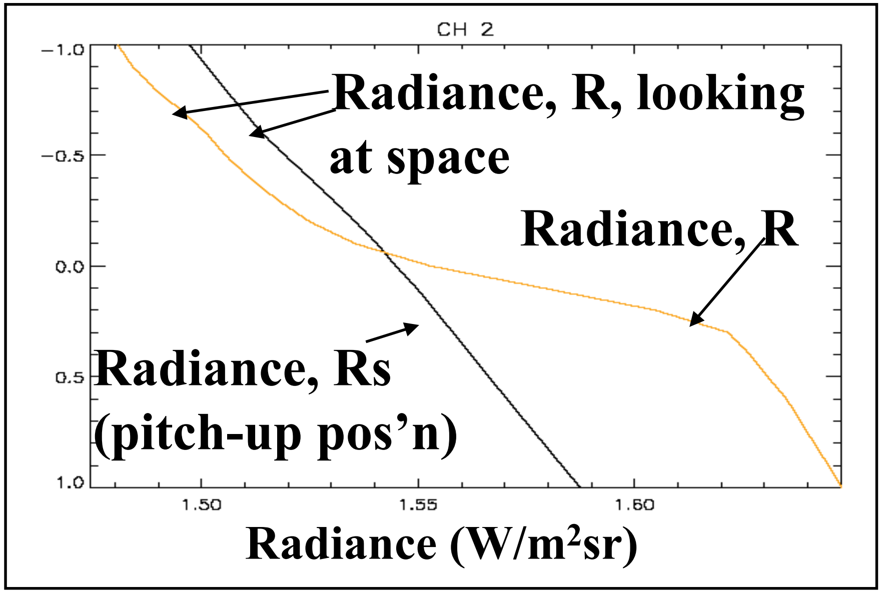
  with nitric acid, and cloud top pressure,

  now released as provisional data
- Present efforts are improving these results, and bringing in other species (H_2O, F11, F12 likely next, also N_2O & NO_2) CH_4, $ClONO_2$ require additional effort. (HIRDLS unique on Aura)
- With these upgrades, HIRDLS is recovering many of its observational capabilities
- HIRDLS WILL FULFILL ITS SCIENCE OBJECTIVES

The End

Approach to Correcting for Obstruction Emission





In normal orientation, Radiance from space and obstruction higher up, atmosphere/earth and obstruction lower down

When S/C pitched down 5.25°, HIRDLS Line of Sight (LOS) pitched up, Radiance is from obstruction only

Therefore, use pitch-up data to begin to estimate signal from obstruction

Radiance when looking at space has quasi-monochromatic oscillations superposed on signals.

First step-remove oscillations.

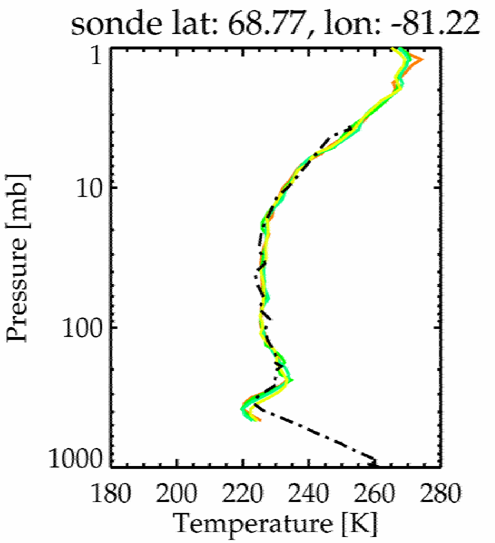
Scan Tables- Differ in vertical scan speed,vertical range, and azimuths

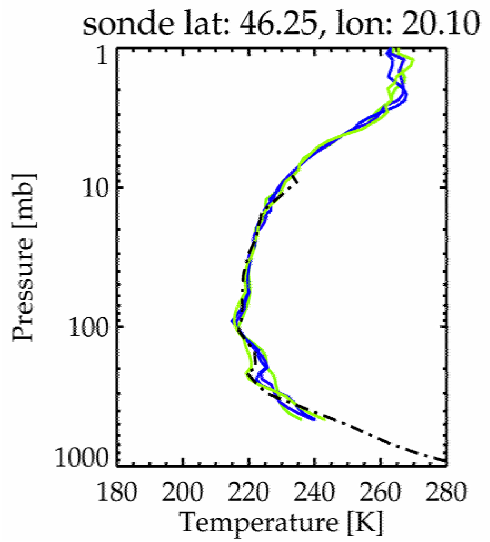
Each has somewhat different pattern of radiance oscillations super-imposed on the radiance signals, requires own deoscillation

Dates covered by scan tables:

Scan Table 30	**January 21 2005-April 28 2005**
Scan Table 13	**April 28 2005- April 24 2006**
Scan Table 22	**April 24 2006- May 3 2006**
Scan Table 23	**May 4 2006- Present**

HIRDLS Temperature Comparisons with Sonde Data: Accuracy and Vertical Structure is Captured



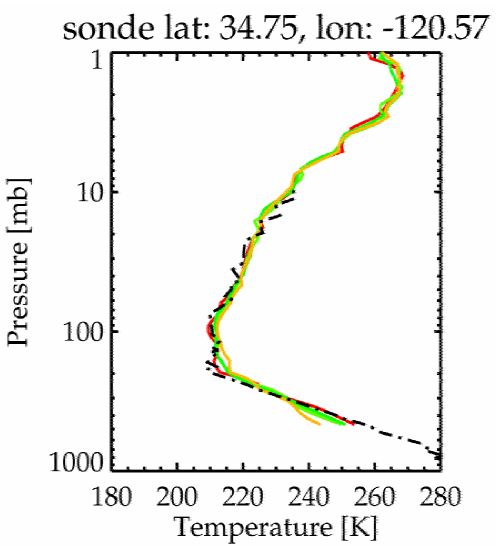


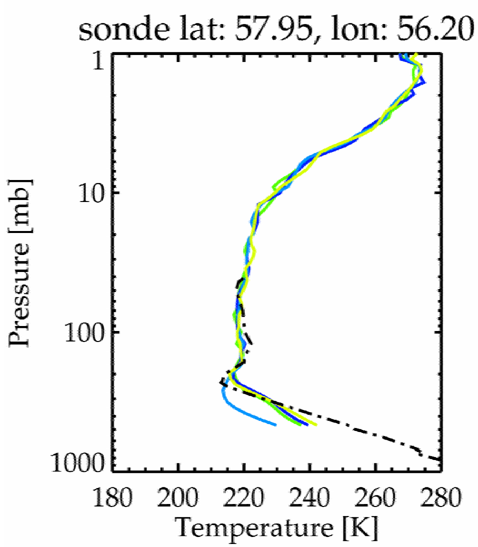
11th May 2005

Radiosonde data (from UK Met Office Global Radiosonde Dataset)

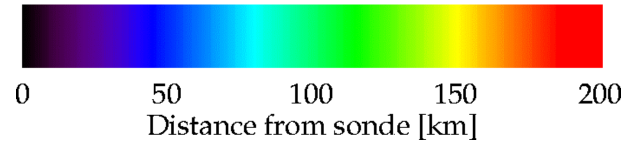
HIRDLS

(colors indicate distance from sonde)



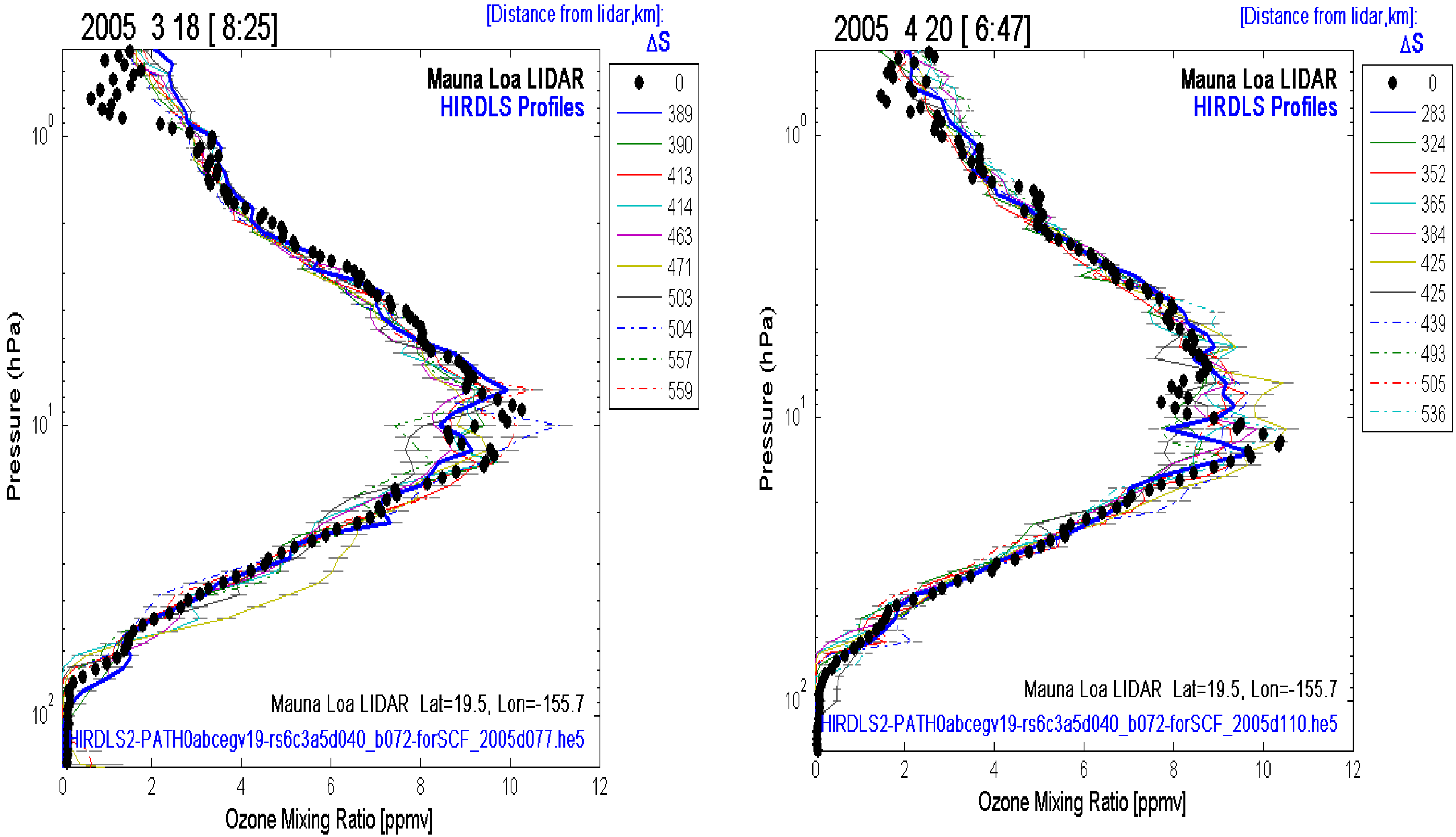


All HIRDLS profiles shown are within 3 hours and 200km of the sonde data.

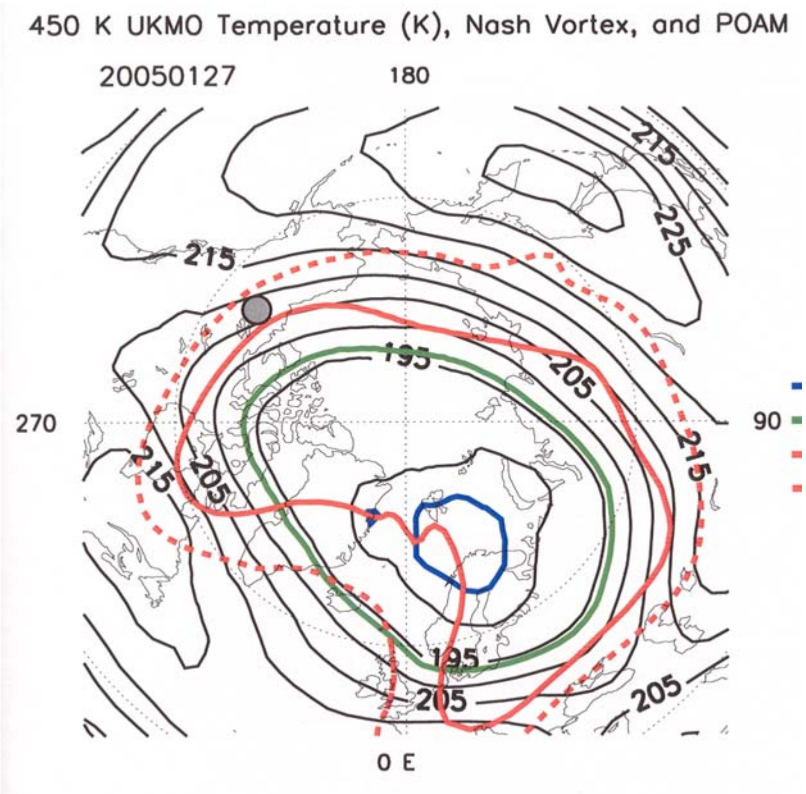


More in Gille et al. poster

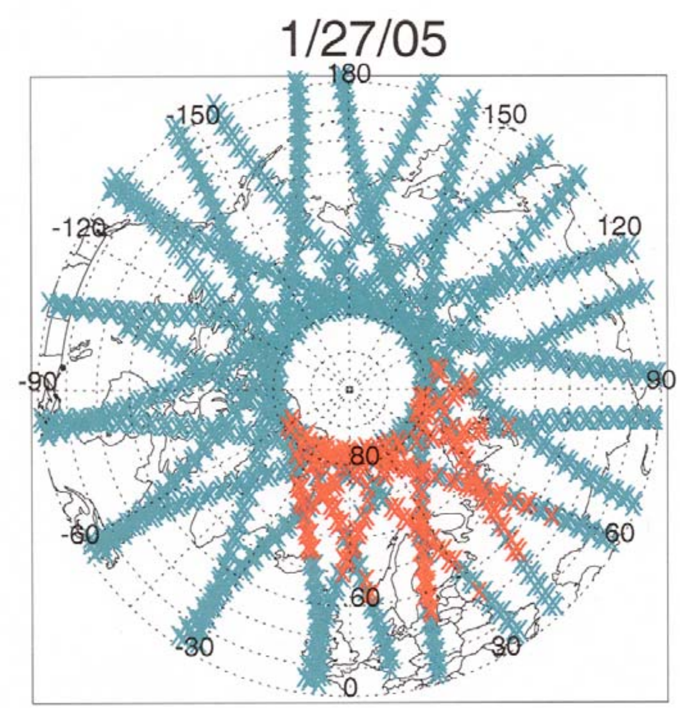
HIRDLS vs Lidar (Mauna Loa)



HIRDLS Uniquely Observes PSCs in Cold NH Polar Region

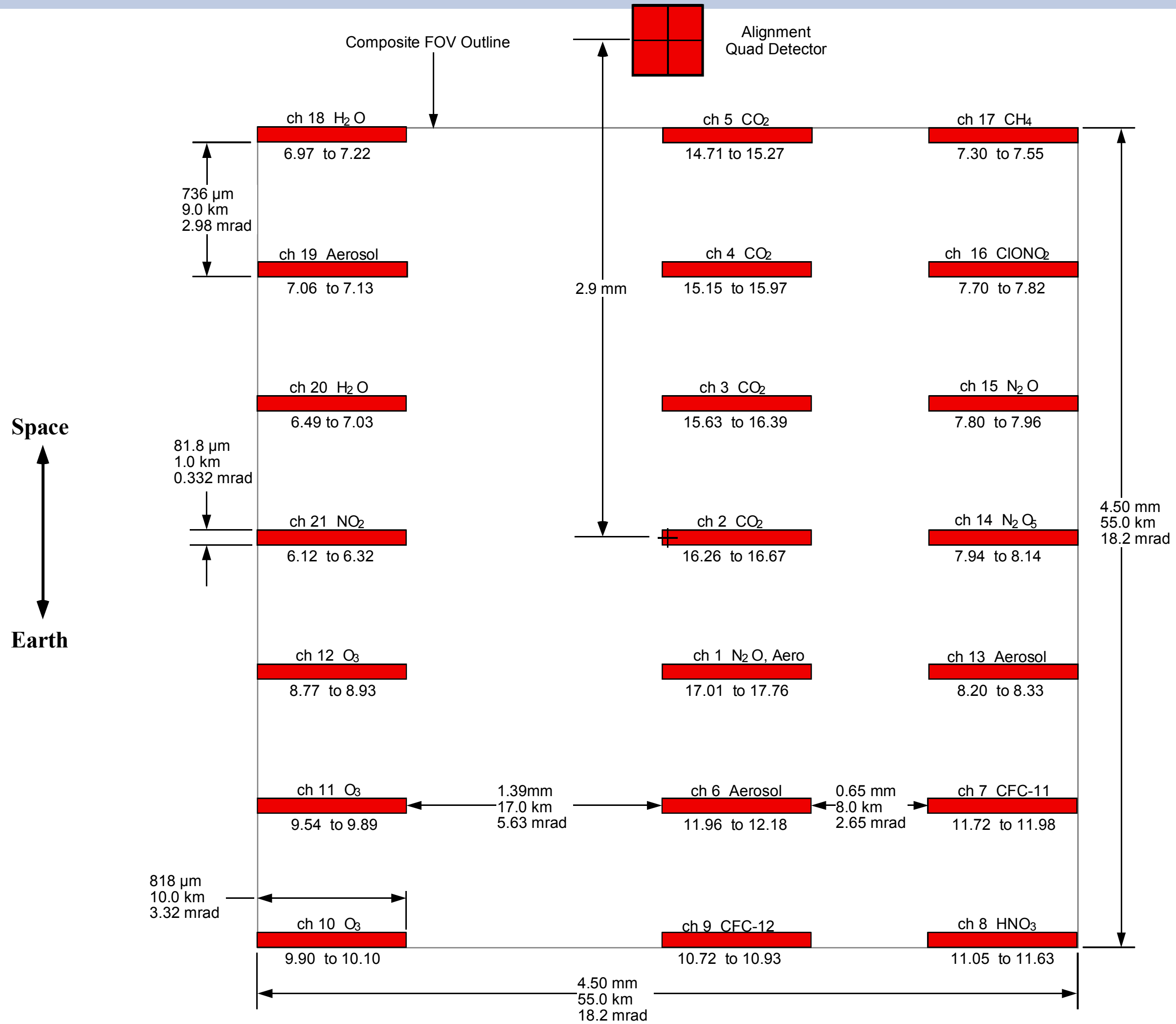


Polar vortex on 27 Jan – courtesy of the POAM group. The green contour marks the region of the 195 K PSC temperature threshold. The blue line marks the ice threshold (for PSC II ice particles). The red lines mark the polar vortex (by the Nash criterion).

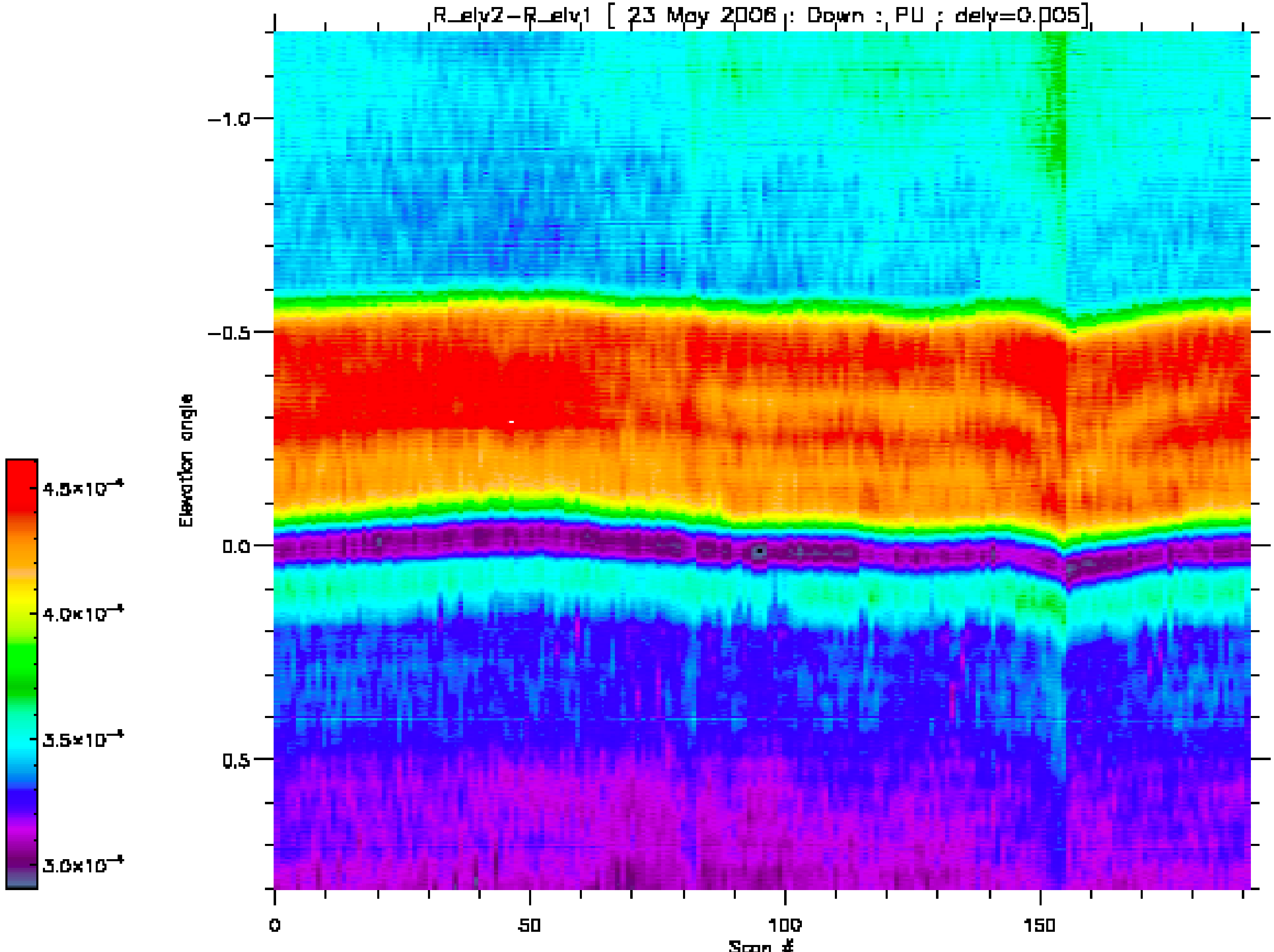


Individual observations of PSCs by HIRDLS 27 Jan 2005. Red crosses are the locations of PSCs (as given by our cloud detection algorithm). Blue crosses are non-cloud observations. By comparing this graph, and the POAM graph, it is apparent that HIRDLS observes many PSC inside the T+195 K temperature contour.

Field-of-View Map

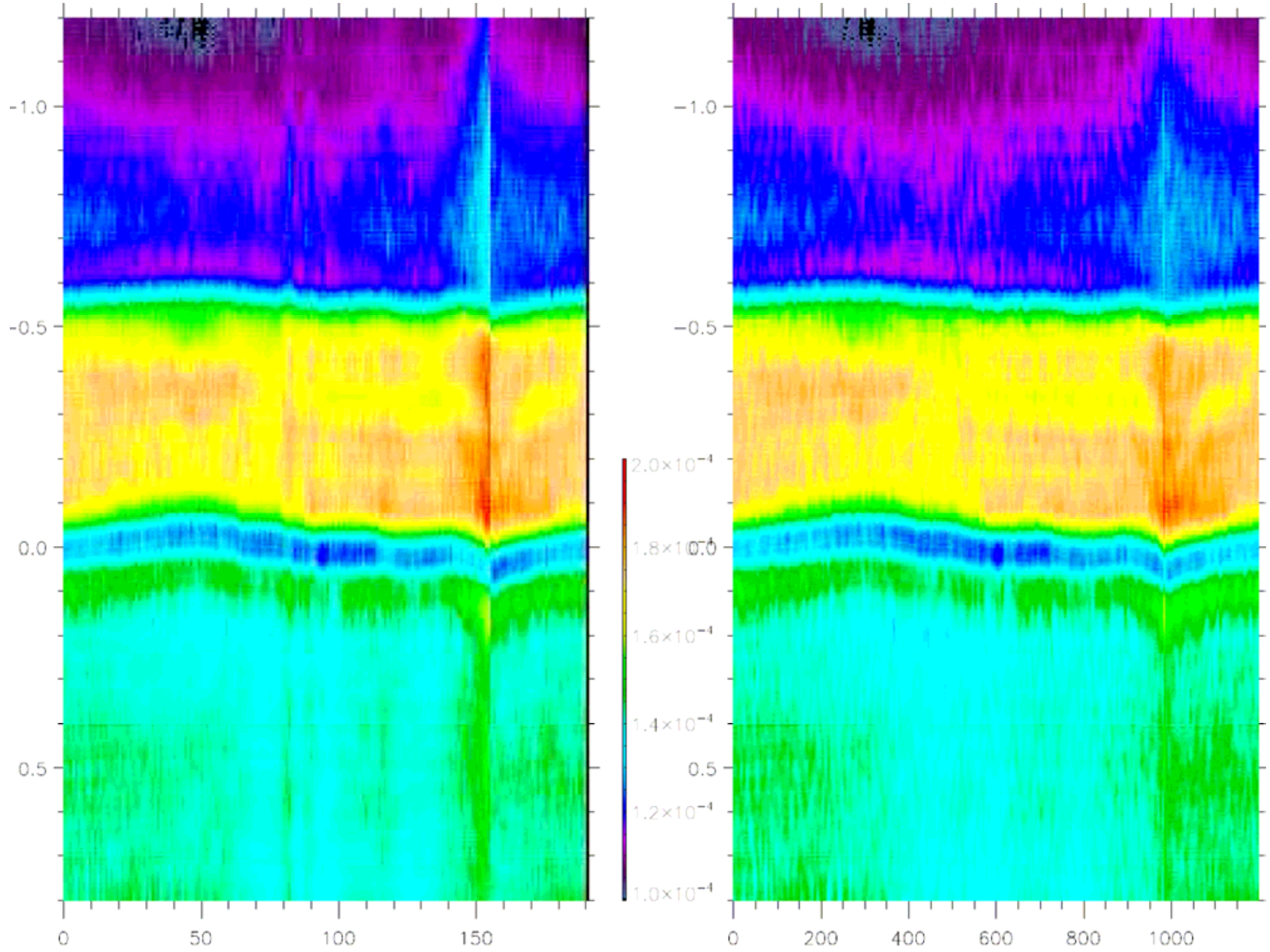


Orbit of Down Scan Gradients- (Includes Effect of T Variations)



Correction of Down Scans for Time Variations

dRad/del ∂Rad/∂el



Sharp variation in dRad/del near sunset reduced significantly in ∂Rad/∂el